FLUID-DYNAMIC CHARACTERIZATION OF ATMOSPHERIC PRESSURE NON-EQUILIBRIUM PLASMA SOURCES FOR BIOMEDICAL APPLICATIONS

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The complexity of plasma interaction with biological material and the stiff requisites imposed by biomedical treatments put a premium on diagnostics as a means to investigate process feasibility and to develop plasma sources tailored for specific applications. Among the several diagnostic techniques adopted in the field of cold non-equilibrium atmospheric pressure plasmas, optical emission spectroscopy (OES), high speed imaging (HSI) and Fourier transform infrared spectroscopy (FTIR) are widely used.

In this work a report is given on the use of Schlieren imaging [1], which has been widely adopted in aeronautics and in thermal plasma science for qualitative and quantitative diagnostics of turbulence, shock waves and flow patterns, for the fluid-dynamic characterization of two different cold non-equilibrium plasma sources. In the first case, an already extensively investigated atmospheric pressure plasma jet (kINPen09, Neoplas Tools GmbH) [2] was analyzed to enlighten the effects of mass flow rate and input power on flow patterns around the plasma region. For a second plasma source, a novel multi-gas device developed by the authors and based on the plasma needle concept [3], Schlieren imaging was adopted to investigate the fluid-dynamics of the afterglow region for different operative conditions and mass flow rates.

Flow fluctuations generated by the effluent when impinging on substrates of different geometries (plain substrate, Petri dishes, etc.) were investigated by means of a fast CCD camera (up to 200,000 fps) coupled with Schlieren technique and subsequent statistical elaboration of raw high-speed recordings.